

a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

4. An apparatus according to claim 2, wherein said disc discriminating means comprises:

- 1 a cartridge for enclosing the optical disc;
- 2 a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and
- 3 detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

5. An apparatus according to claim 1, wherein numerical apertures of at least two or more of said N objective lenses differ.

6. An apparatus according to claim 2, wherein numerical apertures of at least two or more of said N objective lenses differ.

7. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal by converging a light flux onto/from a recording layer through a transparent disc substrate, comprising:

(a) an optical head having N, N being greater than or equal to 2, converging optical systems each comprising:

light emitting means,

objective lenses, whose aberrations have respectively been corrected for said N disc substrates having different thicknesses, each for converging the light flux which is emitted from the light emitting means onto the optical disc and

a plurality of photo detecting means each for detecting the reflected light from the optical disc;

(b) optical head moving means which is arranged below the optical disc and moves the optical head in the radial direction of the optical disc;

(c) disc discriminating means for discriminating the thickness of the disc substrate of the loaded optical disc and for generating a discrimination signal in accordance with the result of the discrimination; and

(d) control means for allowing the light emitting means, which belongs to the converging optical system in which the occurrence of the aberration due to the disc substrate is smallest in accordance with the discrimination signal, to emit light,

wherein the selected converging optical system records, reproduces or erases the information signal onto/from the optical disc.

8. An apparatus according to claim 7, wherein said disc discriminating means comprises:

a cartridge for enclosing the optical disc;
a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and
detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

9. An apparatus according to claim 7 wherein numerical apertures of at least two or more of said N objective lenses differ.

10. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal by converging a light flux onto/from a recording layer through a transparent disc substrate, comprising:

(a) an optical head including:

light emitting means,

light flux dividing means which are arranged in the light flux from the emitting means and divide the emitted light flux into N , N being greater than or equal to 2, light fluxes and deflect in different directions,

N objective lenses, whose aberrations have respectively been corrected for said N disc substrates having different thicknesses, for respectively converging said N light fluxes onto the optical disc, light flux selecting means for selecting one of the N light fluxes divided by the light flux dividing means and for allowing said light flux to pass, and photo detecting means for detecting the light fluxes reflected by the optical disc.

(b) optical head moving means which is arranged below the optical disc and moves the optical head in the radial direction of the optical disc;

- (c) disc discriminating means for discriminating the thickness of the disc substrate of the loaded optical disc and for generating a discrimination signal in accordance with the result of the discrimination; and

(d) control means for generating a control signal to the light flux selecting means in accordance with the discrimination signal and for selecting the light flux which passes through the objective lens in which the occurrence of the aberration due to the disc substrate is smallest,

wherein the optical head records, reproduces or erases the information signal onto/from the optical disc by the selected light flux.

11. An apparatus according to claim 10, wherein said disc discriminating means comprises:

a cartridge for enclosing the optical disc;

a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and

detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

12. An apparatus according to claim 10, wherein numerical apertures of at least two or more of said N objective lenses differ.

13. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal by converging a light flux onto/from a recording layer through a transparent disc substrate, comprising:

(a) an optical head including:

an optical waveguide formed on a substrate.

N light emitting means each for emitting a waveguide light into said optical waveguide, **N** being greater than or equal to 2.

N converging grating couplers, whose aberrations have respectively been corrected for said N disc substrates having different thicknesses, each for emitting the waveguide light supplied from said N light emitting means to the outside of the optical waveguide and for allowing the reflected light from the optical disc to enter, and

N photo detecting means each for detecting reflected light and for generating an information signal;

- (b) optical head moving means which is arranged below the optical disc and moves the optical head in the radial direction of the optical disc;
- (c) selecting means for selecting the light emitting means to be allowed to emit the light from among the N emitting means;
- (d) disc discriminating means for discriminating the thickness of the disc substrate of the loaded optical disc and for generating a discrimination signal according to the result of the discrimination; and
- (e) control means for generating a control signal in accordance with the discrimination signal, for providing said control signal to said selecting means and for allowing the light emitting means for emitting the waveguide light into the converging grating coupler in which the occurrence of the aberration due to the disc substrate is smallest, wherein the optical head records, reproduces or erases the information signal onto/from the optical disc by the light flux from the selected light emitting means.

14. An apparatus according to claim 13, wherein said disc discriminating means comprises:

- a cartridge for enclosing the optical disc;
- a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and
- detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

15. An apparatus according to claim 13, wherein numerical apertures of at least two or more of the N converging grating couples differ.

16. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal by converging a light flux onto/from a recording layer through a transparent disc substrate, comprising:

(a) an optical head including:
an optical waveguide formed on a substrate,
light emitting means for emitting a waveguide light
into said optical waveguide,
light flux dividing means for dividing the waveguide
light emitted from the light emitting means into N
divided waveguide lights, N being greater than or
equal to 2,
said N converging grating couplers, whose aberrations
have respectively been corrected for said N
disc substrates having different thicknesses, each
for emitting each of said N divided waveguide
lights to the outside of the optical waveguide and
for allowing the reflected light from the optical
disc to enter, and
N photo detecting means for respectively detecting
said reflected lights from the N converging grating
couplers and for generating information signals;

(b) optical head moving means which is arranged
below the optical disc and moves the optical head
in the radial direction of the optical disc;

(c) output switching means for selecting and outputting
one of the output signals of said N photo detecting
means;

(d) disc discriminating means for discriminating the
thickness of the disc substrate of the loaded optical
disc and for generating a discrimination signal in
accordance with the result of the discrimination;
and

(e) control means for generating a control signal to the output switching means in accordance with the discrimination signal and for selecting the photo detecting means into which the waveguide light enters from the converging grating coupler in which the occurrence of the aberration due to the disc substrate is smallest.

17. An apparatus according to claim 16, wherein said disc discriminating means comprises:

a cartridge for enclosing the optical disc;
a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and
detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

18. An apparatus according to claim 16, wherein numerical apertures of at least two or more of the N converging grating couplers differ.

19. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal by converging a light flux onto/from a recording layer through a transparent disc substrate, comprising:

(a) an optical head including:
an optical waveguide formed on a substrate,
light emitting means for emitting a waveguide light into said optical waveguide,
optical path switching means which is arranged on an optical path of said waveguide light and switches the propagating direction of the waveguide light in N directions in accordance with a control signal, N being greater than or equal to 2,
N converging grating couplers, whose aberrations have respectively been corrected for said N disc substrates having different thicknesses and which are respectively arranged in said N propagating directions which are switched by said optical path switching means and emit the waveguide light to the outside of the optical waveguide and allow the reflected light from the optical disc to enter, and
photo detecting means for detecting the reflected light and generating an information signal;
(b) optical head moving means which is arranged below the optical disc and moves the optical head in the radial direction of the optical disc;
(c) disc discriminating means for discriminating the thickness of the disc substrate of the loaded optical disc and for generating the discrimination signal in accordance with the result of the discrimination; and

(d) control means for generating a control signal to the optical path switching means in accordance with the discrimination signal and for switching the propagating direction of the waveguide light from the light emitting means to the direction of the converging grating coupler in which the occurrence of the aberration due to the disc substrate is smallest,

wherein the optical head records, reproduces or erases the information signal onto/from the optical disc by the light flux emitted from the selected converging grating coupler.

20. An apparatus according to claim 19, wherein said optical path switching means combines deflecting means for changing the propagating direction of the waveguide light by a deflection angle according to an input signal,

and wherein said apparatus comprises:

tracking error detecting means for detecting a tracking error amount of a converged spot which has been converged onto the optical disc and for generating a tracking error signal; and

tracking control means for changing the input signal to the deflecting means in accordance with said tracking error signal and for eliminating the tracking error of the converged spot.

21. An apparatus according to claim 19, wherein said disc discriminating means comprises:

a cartridge for enclosing the optical disc

a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and

detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

22. An apparatus according to claim 20, wherein said disc discrimination means comprises:

a cartridge for enclosing the optical disc;

a discrimination hole which is formed on the cartridge and whose opening/closing state differs in correspondence to the thickness of the disc substrate of the optical disc; and

detecting means for detecting the opening/closing state of the discrimination hole and for generating a discrimination signal.

23. An apparatus according to claim 19, wherein the numerical apertures of at least two or more of the N converging grating couplers differ.

24. An apparatus according to claim 20, wherein numerical apertures of at least two or more of the N converging grating couplers differ.

25. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal onto/from any one of N types (where $N \geq 2$) of optical discs having transparent substrates of different thicknesses, each type of said optical discs having at least a transparent substrate and an information layer, by converging a light flux onto said information layer through said transparent substrate, said apparatus comprising:

a converging means having N different numerical apertures for converging the light flux on said information layer of a corresponding one of said N types of optical discs.

wherein said converging means converges said light flux by employing a larger one of said N numerical apertures, with respect to one of said optical discs having a thinner one of said substrates.

wherein thicknesses of said transparent substrates of said N types of optical discs are substantially equal to or less than 1.2mm and said N numeral apertures in said converging means are substantially equal to or larger than 0.45.

26. An optical recording/reproducing apparatus for recording, reproducing or erasing an information signal onto/from any one of N types (where $N \geq 2$) of optical discs having first layers of different thicknesses, each type of said optical discs having at least a first layer which is transparent and a second layer for storing information, by converging a light flux onto said second layer through said first layer, said apparatus comprising:

a converging means having N different numerical apertures for converging the light flux on said second layer of a corresponding one of said N types of optical discs.

wherein said converging means converges said light flux by employing a larger one of said N numerical apertures, with respect to one of said optical discs having a thinner one of said first layers.

wherein thicknesses of said first layers of said N types of optical discs are substantially equal to or less than 1.2mm and said N numeral apertures in said converging means are substantially equal to or larger than 0.45.

27. An optical recording/reproducing apparatus according to claim 25, wherein each of said N converging means is an objective lens.

28. An optical
recording/reproducing apparatus according
to claim 25, wherein each of said N
converging means is a grating lens.

29. An optical recording/reproducing apparatus according to claim 26, wherein each of said N converging means is an objective lens.

30. An optical recording/reproducing apparatus according to claim 26, wherein each of said N converging means is a grating lens.

31. An apparatus according to claim 25, further comprising disc discriminating means for discriminating a type of said optical disc loaded in said apparatus and for outputting a discrimination signal according to a discrimination result, and a control means for selecting one of said N numerical apertures that generates a least aberration due to the transparent substrate of the optical disc loaded in said apparatus.

32. An apparatus according to claim 31, wherein said discriminating means comprises:

a cartridge for enclosing the optical disc loaded in said apparatus;
said cartridge having a discrimination hole which has an open/closed state characteristic which differs depending on a type of said optical disc loaded in said apparatus: and
detecting means for detecting the open/closed state characteristic of said discrimination hole.

26. further comprising disc discriminating means for discriminating a type of said optical disc loaded in said apparatus and for outputting a discrimination signal according to a discrimination result, and a control means for selecting one of said N numerical apertures that generates a least aberration due to the transparent first layer of the optical disc loaded in said apparatus.

34. An apparatus according to claim 26, wherein said discriminating means comprises:
a cartridge for enclosing the optical disc loaded in said apparatus;
said cartridge having a discrimination hole which has an open/closed state characteristic which differs depending on a type of said optical disc loaded in said apparatus; and
detecting means for detecting the open/closed state characteristic of said discrimination hole.

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